Building a Customer Requirement Based Supplier Quality Management System

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Abstract

This study utilizes quality function deployment to establish a strategic model that transfers customer requirements for an IC substrate to build action schemes that improve supplier quality management. This study focuses on the transfer of customer requirements of the IC substrate and builds an effective supplier quality-management system that meets customer requirements, such that firms can maintain their competitiveness in the IC substrate industry. Quality function deployment in this study is a method to integrate and merge customer requirements into the supplier quality-management process. This study applies a two-stage deployment including operation and action planning. Study findings will enhance IC substrate manufacturing quality when suggested improvements are implemented.

Keywords

IC Substrate; Supplier Management System; Quality Function Deployment

Introduction

To respond to the highly competitive global marketplace, using modern manufacturing equipment and technology as well as increasing the quality of customer requests are essential to maintain competitiveness in the IC substrate manufacturing industry. Enhancing and managing supplier quality is an important issue for all IC substrate manufacturers.

Most enterprises only focus on internal requirements and overlook execution of supplier quality-management systems. That is, firms rarely integrate customer requirements into their supplier quality-management system. Thus, time and cost in dealing with problems of how to make a production process meet customer requirements increase when customer requirements are not integrated into the supplier quality-management system. Therefore, a supplier quality-management systemt

hat is based on customer requirements is needed. Such a system can reduce costs associated with meeting customer requirements, and can integrate supplier resources to meet customer requirements.

An IC substrate is the media between an IC and a PCB. The interior of an IC substrate has a circuit routing that connects the IC and PCB. The purpose of an IC substrate is to ensure that electronic circuit functions work properly. The main materials in an IC substrate include copper foil, resin, dry film (solid photoresist), wet ink (liquid photoresist), and metal materials (e.g., steel ball, nickel ball, and gold potassium cyanide). Enterprises must manage their supplier quality system efficiently. Indeed, a good supplier-quality management system can satisfy customer requirements from a technical service perspective. Therefore, to achieve high profit and manufacture customized IC substrate products, the PCB industry requires a supplier quality-management system that is based on customer requirements. Suppliers must meet enterprise requirements and a customer's actual requirements.

This study applies the quality function deployment method to establish a supplier quality-management system based on customer requirements. This system will assist enterprises through supplier quality-management actions and prioritize each action to meet customer requirements efficiently.

Building the Strategic Model

This study applies quality function deployment to establish a strategic model that improves supplier quality management. Quality function deployment is a well-used method to integrate and merge customer requirement into the management system (Besterfield *et al.* 2003). The advantage of quality function deployment is that it can be applied to product and service development (Dror and Sukenik 2011; Leary and Burvill 2007; Liang *et al.* 2006; Yang and Fang 2003), and help in planning, assessing and improving

managerial systems. (Büyüközkan *et al.* 2007; Chang 2006; Raharjo *et al.* 2007; Yang *et al.* 2006). Yang et al. (2009) applied the quality function deployment to a two-stage deployment including the ability of the operation and action scheme planning for selecting subcontractors for foreign direct investment project. Yang et al. (2012) presented a strategic model for building a green manufacturing system that is based on quality function deployment technique to help industry exploit green manufacturing trend.

Given the objective of building supplier quality management system, this study applies the quality function deployment to a two-stage deployment, including the operational ability and action plan. Figure 1 shows the proposed framework. In deploying operational abilities, inputs on the left side of the QFD matrix are segmented by customer requirements, including quality, management, process control, out-going control, training, an environment-related substance control system, and design review. At the top of the QFD matrix is operational deployment ability, which is segmented by the main enterprise departments (*i.e.*, the sales department, technology department, manufacturing department, engineering department, materials department, quality department, and R&D department). Customer requirements are weighted based on a customer's opinions. To prioritize operational abilities, the relevance was examined by completing the relationship matrix. The score for operational ability in each box is multiplied by the weight of each item. The priority of improvement is the total score for that column. The highest score is considered as the highest priority item for improvement.

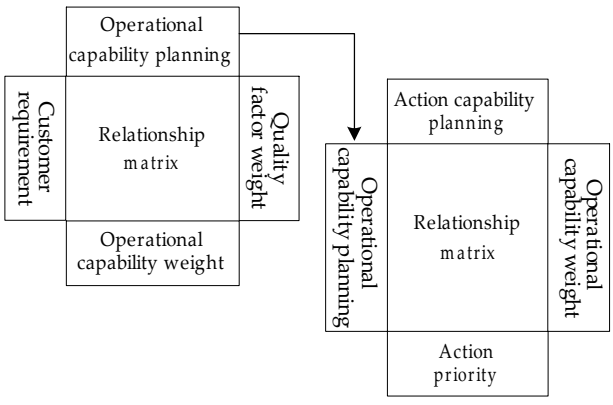

FIG. 1 THE FRAMEWORK OF THE SUPPLIER QUALITY MANAGEMENT

To deploy the action scheme, operational ability planning is input at the end of the first stage. The improvement priority score from the previous QFD matrix is recorded on the right side of the operational ability weight. At the top of the output section of the QFD matrix, the main action plans for improvement are evaluated to generate an action scheme. The priority of each segment is deployed in action scheme planning. After completing the relationship matrix for operational ability and the action plan, scores on each square are multiplied by the corresponding weight of operational ability. The multiplication result is then entered into the lowest side of each column. This number represents the priority of an enterprise action scheme. The highest number, the most important, indicates that an action must be undertaken.

Deployment of Operational Ability

Demand for customer requirements

In terms of customer requirements, this study focuses on large international IC package firms that have high quality requirements, finding the main requirements, and generating a customer requirement list. The sources of customer requirements are as follows; the first source is quality and audit data; the second source is the ISO/TS16949 quality system-related requirements (ISO/TS 16949 quality management system is a particular requirement for the application of ISO 9001 for automotive production and relevant service part organizations); and the third source is the management requirement restricting the use of hazardous substances. To analyze these three sources of customer requirements, ten experts (manager of purchasing department, operation engineer and manager, manager of customer) have been consulted to plan and select the customer requirement items. This study divides all customer requirement items into six categories based on their features. The following six items show the customer quality and specified requirements.

1. Quality system and management: An internal audit and self-audit are used to determine whether the internal system is functioning effectively. This includes all processes, activities, and production arrangements in annual planning that are related to quality management.
2. Process control: Customer requirements for process control include product recognition and tracking, manufacturing process control, nonconforming product control, inspection, and SPC application.
3. Out-going control: Before shipping, product reliability is assessed and physical measurements are taken.

TABLE 1 LISTS THE VARIOUS QUALITY ELEMENTS

Quality system and management	An internal audit system exists
	The SOP self-audit requirement is defined and monitored via management reviews
	The SOP internal audit requirement is defined and monitored by management reviews
Process control	The control plan, FMEA and QC flowchart exist
	Appropriate equipment, a separated area, and flow exist during product manufacturing for material stores, and release and control
	An SPC system exists that controls process yield
	Process change control flow is defined
	Special instructions for process flow are obtained from customers
	Sufficient information exists for tracing product
	A traveler card system for operators is used to identify process instructions
	The supplier has the specs for abnormal lots
Outgoing control	It is appropriate for outgoing inspection flow/item/sampling size
	The outgoing stock environment is controlled
	A systematic method exists for controlling the accuracy on COA
	The storage condition during product delivery and transportation is defined and controlled properly (e.g., temperature, humidity, particle, DIW)
	Product verification ensures that products without quality concerns have the guaranteed shelf life
	A clear status notice exists for products and product acceptance and rejection are controlled separately
Training	A certification flow and re-certification flow exist for process operators
	It defines the training class list that quality department employees need to be taken
	Training effectiveness is evaluated
Environment-related substance control system	Specifications are used to define banned substances and criteria
	Specifications define incoming materials and the out-going monitoring plan for hazardous substances
	A control in the production line exists for environmentally hazardous substances
	To prevent pollution, cleaning standards are used for equipment, fixtures, jigs and tools, and containers, and cleaning has been implemented accordingly
	Specifications define the non-compliant product control flow for environmentally hazardous substances
	For environmentally hazardous substances, a control exists in production line to prevent contamination for sharing production facility
Design review	The organization plans and develops the processes needed for product realization
	Procedures control and verify product design to ensure that it meets all requirements
	A requirement verifies that the product meets design specifications prior to mass production. (e.g., design review and verification)
	The supplier considers the impact of design changes on the system in which a product is used
	Performance is tested, including durability and reliability, and is tracked for timely completion and conformance

4. Training: Employees that can affect product quality should be trained properly. Additionally enterprises should provide training courses to enhance the quality-control abilities of employees.
5. Environment-related substance control system: For sale products the customer requirements complying with regulation; consequently, suppliers must have a quality-control system that complies with regulations for hazardous substances.
6. Design review: During the design and development stage, each design and development stage must be reviewed, analyzed, and approved. These activities should include the product design and process design stages.

Planning of operating ability

Operating ability can be divided into the following departments: R&D, management, manufacturing, engineering, product, QC, and resource integration. These seven departments deconstruct operating ability into three stages. TABLE 2 shows the items on demand for operational ability.

1. The R&D department provides a new manufacturing process for the customer based on market information and research into core competency technology.
2. The management department includes the purchasing division and human resources (HRs) division. The HR division controls manpower and executes training courses. The purchasing division collaborates with suppliers via a supplier management method to integrate cost, quality, and manufacturing techniques into an agreement.
3. The manufacturing department focuses on production planning and execution, and continually improves manufacturing processes and management.
4. The engineering department is responsible for improving and analyzing internal manufacturing processes.
5. The product department receives customer requirements. According to customer-specified materials (e.g. green materials), this department designs green products and assists in implementation of the green manufacturing process to comply with restrictions for the use of hazardous substances.
6. The QC department monitors the quality of TABLE 2

ITEMS ON DEMAND FOR OPERATIONAL ABILITY

R&D department	New process / technology research	New equipment and processes, and evaluation of materials and development to introduce
		New-products simulations
	Project management	Import of the external technical cooperation plan
Management department	Human resources	Implementation of education and training courses
		Human resources planning and coordination
	Procurement capacity	Supplier relationship management
Manufacturing department	Production planning	Product capacity management and delivery to reach
		Mass production planning
	Manufacturing execution	OCAP implementation and abnormal reaction
		Operations management and improvement
		Implementation of process capability checks
		Independent quality assurance
Engineering department	Process improvement	Management and enhancement of process capability
		Product yield management and enhancement
		Manufacturing field failure and exception analysis
		Help improve process variation
	Process to assess	Operating parameter management
		New equipment, materials, and process technology assessment
Product department	Product information reception	Review and verify customer data
		Provide technical services to customers
		Integrate the product design process and manufacturing process
	Sample trial run	Monitoring samples of the delivery achieving rate
QC department	Quality control	Abnormal quality deal with regulation
		Online quality control
	Quality system	Quality document control
		Internal audit system
		Engineering change system management
Resource integration department	Resource control	Raw materials, and product storage management
		Raw materials, and products moving in and out of the warehouse
	Resource planning	Improve the production information system
		Coordinate production allocation
		Develop production plans

incoming, production to out-going, and tracks, improves, and checks the exception status.

7. The resource integration department includes resource control and planning. Resource control is the management of raw materials and product storage, and products moving in and out of warehouses. Resource planning encompasses production schedules and meeting customer orders.

Deployment of Planning

One can construct a relationship matrix that describes the relationship between quality requirements and operational capability planning. This relationship matrix uses signs to represent the relationship between quality requirements and operational capabilities. In this matrix, ◎ represents highly related items, and its numerical value is 5; ○ represents a secondary relationship between two items, and its numerical value is 3; and Δ represents weakly related items, and its numerical value is 1. When no relationship exists between the service quality requirement and operational capability planning, this column is left blank. Scores for interrelated elements among deployed items are multiplied by elements of the quality requirements and then summed to obtain the absolute weight below the quality house. FIG. 3 shows the quality house for deployment of operational capability planning.

Based on the final operational capability result, the top 5 factors in descending importance are online quality control; raw materials, products moving in and out the warehouse; technical assessment and release of new equipment, new materials, and new manufacturing processes; development and implementation of new equipment, new manufacturing processes, and new manufacturing materials; and the internal audit system.

1. Online quality control: Online quality control is assessed via casual inspections by QC staff, and through the measurement analysis system for implementation of monitoring functions.
2. Raw materials and products moving in and out of a warehouse: As IC substrates are highly customized products, it enables accurate and efficient management of raw materials and finished products moving in and out of a warehouse.
3. Assessment and release of new equipment, new materials, and new process technology: High cost is associated with new equipment, new materials,

and new manufacturing processes to produce customized products. Therefore, it must carefully deal with assessment and release.

4. Development and implementation of new equipment, new processes, and new materials: Customized products must meet customer requirements and continually collect and integrate market information to suggest new products to customers.
5. Internal audit system: This audit system includes a quality management system audit, manufacturing process audit, and product audit. An internal audit must address customer requirements and identify the quality status of an enterprise.

Action Planning Deployment

Action Planning Scheme

Action planning schemes primarily focus on the strategic aspects of operating capability items, thus enabling firms to focus their attention and efforts on key actions, which in turn improves quality management capabilities. Action planning schemes mainly apply ISO/TS 16949 as the basic system for supplier quality-management systems. This basic system can be expanded to a quality management system, management responsibility, resource management, product realization, measurement, and analysis and improvement. In considering how to choose items that meet customer requirements associated with these five facets, a supplier quality-management system is needed. To build a supplier quality-management system that fits customer requirements with the five facets. TABLE 3 shows action planning details and explains the following five facets.

1. Quality management system: This system ensures that all relevant documents are correct, easy to understand, and approval version. All relevant quality documents and records must define an effective deadline to meet customer requirements.
2. Management responsibility: Management should have enhancing customer satisfaction as a goal to ensure that customer requirements are met. Each section must set its own goals according to its responsibilities.
3. Resource management: Resource management must be regularly planned, submitted, and reviewed for such resources as manpower, location, special skills, finances, and equipment. These actions can strengthen customer satisfaction and meet customer requirements.
4. Product realization: Organizations typically plan, analyze, and deliver finished products. Thus, an organization should consider planning, quality goals and requirements, the resources needed by these processes, and define inspection activities, monitoring methods, and acceptance criteria.
5. Measurement, analysis and improvement: Organizations must study all new manufacturing processes and provide a plan for reacting to any unstable situation. Additionally, organizations should facilitate continual improvement through data analysis.

TABLE 3 ITEMS ON ACTION SCHEMES

Quality management system	Control of documents
	Control of records
	Records retention
Management responsibility	Quality-management system planning
	Responsibility, authority, and communication
	Management review
Resource management	Human resources
	Providing infrastructure
	Work environment management
Product realization	Planning product realization
	Reviewing product requirements
	Design and development planning
	Verification of purchased product
	Control and validation of production and service provisions
	Control monitoring and measuring devices
Measurement, analysis, and improvement	Monitoring and measuring manufacturing processes
	Monitoring and measuring products
	Control of nonconforming products
	Data analysis
	Continual improvement

Planning Deployment

The operational ability of the quality house is mapped using five factors namely R&D management, manufacturing engineering, product, the QC and resource integration departments, which are used as

quality house requirements. The weighted value of various items is the absolute weight in Phase I. Various matrix items of operating ability planning and the five main facets employed in planning action schemes (*i.e.*, the quality management system facet, the management responsibility facet, the resource management facet, the product realization facet, and the measurement, analysis, and improvement facet) are combined. In the interrelationship matrix, related symbols are entered based on interrelationship strengths and, subsequently, interrelationship scores are assigned. Symbol ◎ suggests a strong interrelationship, and is assigned a weight of 5; ○ suggests an indirect interrelationship, and is assigned a weight of 3; and △ suggests a coordinative process, and is assigned a weight of 1. A blank space suggests that no interrelationship exists, and thus it is assigned a score of 0. FIG. 3 shows the deployment of the quality house in action planning schemes. In action planning schemes, scores for interrelated elements in action program planning are multiplied by the accumulated weight to obtain weights. The weights of various items are calculated based on the weights of operating ability items multiplied by the weights of planning items of operating ability to derive the correct value via summation. Absolute weight calculation results are recorded in the quality house (FIG. 3).

The result of the action-scheme plans show that the top five items with highest absolute weights are document control; monitoring and measuring manufacturing processes; design and development planning; providing infrastructure; and monitoring and measuring products. These five items are analyzed further as follows:

1. Document control: To stop important customer and enterprise information from being leaked, one should be cautious when dealing with customized product documents through the review, approval, modification, saving, and settlement processes.
2. Monitoring and measuring manufacturing processes: To ensure that a manufacturing process is stable, measurement techniques, plan sampling, acceptance criteria, the process flowchart, and control plan of a product line should be maintained when monitoring and measuring manufacturing processes.
3. Design and development planning: To meet a supplier's design and development planning process, which starts from input, review, modification, inspection, and the identification process for ensuring customer requirements are reached.
4. Providing infrastructure: Under a complete infrastructure, to establish reference standards, quality plans, and working instructions that enhance production efficiency and still satisfy customer requirements under an emergency event.
5. Monitoring and measuring products: Monitoring and measuring products should be start with original raw materials and end at finished products, ensuring that product quality and specifications meet customer requirements.

Conclusions

This study utilizes quality function deployment to construct a two-step quality house. This study also provides recommendations for enhancing customer satisfaction and improving supplier quality. The following conclusions are given in two parts.

1. This study utilizes quality function deployment to establish a strategic model that transfers customer requirements for an IC substrate to build action schemes that improve supplier quality management. Comprehensive results of this study, the supplier quality management system of IC substrate products in the PCB industry should establish five quality action plans: document control, monitoring and measuring manufacturing processes, design and development planning, providing infrastructure, and monitoring and measuring products.
2. In terms of items associated with supplier quality, both customers and enterprises mainly request supplier that must consider quality monitoring and manufacturing control as important factors. This means that customized products not only focus on enhancing R&D capabilities, and the supplier management system should consider manufacturing and quality control as important factors.
3. In terms of IC substrate products in the PCB industry, quality fulfillment is the most important factor; however, the details of the management responsibility dimension are also important. To satisfy customer requirements, firms must rely on

an overall team or group to receive customer requirements. Therefore, a supplier quality-management system that fully supports the needs of each organizational department and meets the

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Symbol	Weight	Interrelationship
◎	5	Strong interrelationship
○	3	Indirect interrelationship
△	1	Coordinative process

		R&D department			Management department			Manufacturing department						Engineering department						Product department				QC department					Resource integration department					Weights of quality items
		New process / technology research		Project management	Human resources		Procurement capacity	Production planning		Manufacturing execution				Process improvement				Process to assess		Product information reception			Sample trail run	Quality control		Quality system			Resource control		Resource planning			
		New equipment, new processes, new materials development and implementation	Simulations of new products	Import of external technical cooperation plan	Arrangements and implementation of education and training courses	Human resources planning and coordination	Supplier Relationship Management	Product capacity management and delivery to reach	The plan of mass production to undertake	OCAP implementation and abnormal reaction	Operations management and improvement	The implementation of the process capability check	Independent quality assurance	Management and enhancement of the process capability	Product yield management and enhancement	Manufacturing field failure and exception analysis	To help improve the process variation	Operating parameter management	New equipment, new materials, new process technology assessment and release	Review and verification of customer data	Provide technical services to customers	Integration of product design process	Monitoring samples of the delivery achieving rate	Abnormal quality deal with regulation	Online quality control	Quality document control	Internal audit system	Engineering change system management	Raw materials, products storage management	Raw materials, products into and out management of warehouse	To improve the production information system	Coordinate resource of production allocation	The development of production plans	
Quality System and Management	There is the internal audit system				△					△						△					△			○		○	◎	○						3.5
	SOP self audit requirement is defined and monitored by management review				△					△		△	○	△		○		○				△		○	○	○	◎							3.8
	SOP internal audit requirement is defined and monitored by management review				△					△		△	△	△	△	△	△							○	○	○	◎	○	○	○					3.8
Process Control	There is the control plan , FMEA and QC flow chart	△						△	○		○			○	△			○	○	△		○			○	○	○		○	△	○		△	4.2
	There is a appropriate equipment、separated area and flow during product manufacturing for material store、release and control								△	△	△														○				○	◎	△	△		4.0
	There is a SPC system to control the process yield	△	△		△			△	○	○	○	◎	△	◎	○		◎	○	○			○	○	△	○								△	3.8
	The process change control flow has defined	△	△		△				○		△	○	△		○	△	△	○	○	○		△		△	○		△	◎				△		○	4.0
	The special instruction of process flow has controlled from customer	◎	◎		○				○	△	△	△	○	◎	○			◎	◎	◎		○		△	○		○	○		○	△			○	5.0
	There is enough information to identify the product for traceability	○							○	○			○	△		○	△	○	○	△				○	○	◎	○	○		○		△			4.2
	There is a traveler card system for operator to identify the process instruction				◎	△		○	○	△	○		△			△		○				○	○		○	○	○				◎			○	4.5

	Supplier has the spec for abnormal lot				△	△		△	○	◎			△			◎								◎	○	○	△			○				4.0
Out-going Control	It is appropriate for out-going inspection flow / item / sampling size	△			△		○			○				△					△				△	△	△		○		◎				3.8
	The out-going stock environment is controlled														△													◎	○				3.6
	There is systematic method to control the accuracy on COA						△								△			△		△								○	○				3.2
	The storage condition during product delivery/transportation defined and controlled properly, Ex. temperature, humidity, particle, DIW.	△					△			△					△								△	△				◎	○				3.8
	There is product verification to ensure the product without any quality concern within the guaranteed shelf life	○					○			△			○		○		△			◎	△	△		△	○			◎	◎				4.5
	There is clear status notice for product and accept product and reject product are controlled separately	○											△			○								○	○		△		◎	◎				4.0

Symbol	Weight	Interrelationship
◎	5	Strong interrelationship
○	3	Indirect interrelationship
△	1	Coordinative process

		R&D department			Management department			Manufacturing department						Engineering department						Product department				QC department				Resource integration department					Weights of quality items
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		New equipment, new processes, new materials development and implementation	Simulations of new products	Import of external technical cooperation plan	Arrangements and implementation of education and training courses	Human resources planning and coordination	Supplier Relationship Management	Product capacity management and delivery to reach	The plan of mass production to undertake	OCAP implementation and abnormal reaction	Operations management and improvement	The implementation of the process capability check	Independent quality assurance	Management and enhancement of the process capability	Product yield management and enhancement	Manufacturing field failure and exception analysis	To help improve the process variation	Operating parameter management	New equipment, new materials, new process technology assessment and release	Review and verification of customer data	Provide technical services to customers	Integration of product design process	Monitoring samples of the delivery achieving rate	Abnormal quality deal with regulation	Online quality control	Quality document control	Internal audit system	Engineering change system management	Raw materials, products storage management	Raw materials, products into and out management of warehouse	To improve the production information system	Coordinate resource of production allocation	The development of production plans	
Training	There is a certification and re-certification flow for process operator				◎	○	△	△	△	○	○	○	◎	△	△	△	△	△	△					○	○				○	○				4.2
	It defines the training class list that quality department employee need to be taken				◎	○	△	△	△	○	○	○	◎	◎	◎	○	◎	○	○		○			○	○	△	◎	△						3.7
	The training effectiveness is evaluated				◎	○		△	△	○	○	○	○	◎	○	○											◎							4.0

Environment-Related Substance Control System	There is a specification to define the environmental banned substance items and criteria	○			○		○		△										○	△	○	△						○						4.0
	There is a specification to define the material incoming and out-going monitor plan for environment-related substance	△					○														○				△	○		○		○	○				3.8
	There is a control in production line for environmental hazardous substance	△			○		△	△	△	○	○		○						△							○		△				○	△	△	3.8
	The preventive pollution, cleaning standards are available for used equipment, fixture, jigs/tools and containers, and cleaning has been implemented accordingly	△			△		△	△	△		△								△	△						△			△					4.0
	There is a specification to define the non-compliant product control flow for environmental hazardous substance				△			△	△	◎			△			◎									◎	○	△	△			○				4.0
	For environmental hazardous substance, there is a control in production line to prevent contamination for sharing production facility				○		△	△	△		○								○							△						△	○	△	4.0
Design Review	The organization shall plan and develop the processes needed for product realization	◎	○	◎			○		○				△	△	○		○	○	◎	○	△	○	○							△		△	4.2
	There are procedures to control and verify the design of the product to ensure it is meeting all requirements	○	◎	◎			△					△	△	△	○		○	○	◎	○	△	◎	○		△	△	△				△			4.5
	There is a requirement to verify the product meets design specifications prior to mass production. (e.g., design review/verification)	○	○	◎					○		△	△	△	△	○		○	○	◎	○		○	△		△						△			4.5
	The supplier considers the impact of design changes on the system in which the product is used	○	○	○										△	△		○		○	○	○	◎	△					◎						4.0
	The performance is testing (that considers and includes as appropriate life, durability, reliability) tracked for timely completion and conformance	○	◎	○			○	○							△		△		○	○	○	△	△											4.5
absolute weight scores		175.6	115.9	91.5	167.1	44.2	105.6	62.5	138.3	155.4	105.5	88.3	156.7	119.5	149.1	115.6	117.8	155.4	191.6	163.8	58	125	71.6	150.3	219.9	95.8	170.8	143.1	127.5	200.3	64.1	66	56.3	

FIG. 2 THE QUALITY HOUSE OF DEPLOYMENT OF OPERATION ABILITY PLANNING

Symbol	Weight	Interrelationship
◎	5	Strong interrelationship
○	3	Indirect interrelationship
△	1	Coordinative process

Quality management system	Management responsibility	Resource management	Product realization	Measurement, analysis and improvement of quality

			Control of documents	Control of records	Records retention	Quality management system planning	Responsibility, authority and communication	Management review	Human resources	Providing infrastructure	Work environment management	Planning of product realization	Review of requirements related to the product	Design and development planning	Verification of purchased product	Control and validation of production and service provision	Control of monitoring and measuring devices	Monitoring and measurement of manufacturing processes	Monitoring and measurement of product	Control of nonconforming product	Analysis of data	Continual improvement	
RD department	New process / technology research	New equipment, new processes, new materials development and implementation	○	△	○		△	△		○	△	△	△	◎	△	△					△	△	175.6
		Simulations of new products	○	△	△			△		○		○	○	○	△	△					△	△	115.9
	Project management	Import of external technical cooperation plan	△		△		△	△		△	△	△		◎	△								91.5
Management department	Human resources	Arrangements and implementation of education and training courses	○	○	○	△	○		◎		△	○	△	△	△	△	△					△	◎	167.1
		Human resources planning and coordination		△		△	◎	△	◎			○		△		△							△	44.2
	Procurement capacity	Supplier Relationship Management	△		○	△	△					△	△	△	◎								△	105.6
Manufacturing department	Production planning	Product capacity management and delivery to reach				△			△	○		△		△		△		○	○					62.5
		The plan of mass production to undertake				△			○	○		△		△		△		○	○					138.3
	Manufacturing execution	OCAP implementation and abnormal reaction	○	△	○				△			△		△		△	△	◎		○	△	△		155.4
		Operations management and improvement	△	△			△		△	△	○	△	△	△		△	△	◎	○		△	○		105.5
		The implementation of the process capability check		△	○				△							△		◎			△	△		88.3

		Independent quality assurance	○	△					△		△					△	△	◎	○			△	156.7
Engineering department	Process improvement	Management and enhancement of the process capability	△				△		△	○	△	△	△	△		△		○			△	○	119.5
		Product yield management and enhancement	△				△		△		△	△	△	△	△	△		○	◎		△	○	149.1
		Manufacturing field failure and exception analysis	○	△	○				△		△					△	△	○	○	◎	○	△	115.6
		To help improve the process variation	△				△		△	○	△	△		△		△		○			△	○	117.8
	Process to assess	Operating parameter management	○	○	△					○	△	○	△	○		△	△	○			△	△	155.4
		New equipment, new materials, new process technology assessment and release	○	○			△			◎	△	△	△	○		△		△				△	191.6
Product department	Product information reception	Review and verification of customer data	◎	○	○		△					△	◎	○	△				○		○	△	163.8
		Provide technical services to customers	○	△	△		△		△				△	○					○		△	△	58
		Integration of product design process		△	△		△					○	△	○					○		△	△	125
	Sample trail run	Monitoring samples of the delivery achieving rate	△		△									△					△				71.6
QC department	Quality control	Abnormal quality deal with regulation	○	○	○		△	△	△	△		△		△	○	△		○	○	◎	○	△	150.3
		Online quality control	○	○	○			△	△	△	△	△		△		△	○	○	○	○	△	△	219.9
	Quality system	Quality document control	◎	△	△	△	△	△	△			○	○	○	○	○	○	○	○	○	○	△	95.8

		Internal audit system	◎	△	△	○	△	○	△	△	△	△	△	△	△	△	△	△	△	△	△	△	170.8
		Engineering change system management	○	△	△		△	△	△	△			△			△		△			△		143.1
Resource integration department	Resource control	Raw materials, products storage management	△	△	△					○	◎				○				△	△			127.5
		Raw materials, products into and out management of warehouse	△	△	△					○	◎				○				△	○			200.3
	Resource planning	To improve the production information system										△				△					△	△	64.1
		Coordinate resource of production allocation					△			◎	○	△				△							66
		The development of production plans	△	△	△							△				△							56.3
absolute weight scores			8710.5	5078.3	5436	1125.9	2751.3	1548.7	3379.7	5807.5	3984.1	4413.8	3120.4	5829.6	3283.5	3216.4	1973.6	7007.6	5489.9	3642	3707	4663.2	

FIG. 3 THE QUALITY HOUSE OF DEPLOYMENT OF ACTION SCHEMES PLANNING